Eastern Copperhead Radio Telemetry, Restoration and Rare Species Stewardship at Baldpate Mountain

2023 Holden Grant Final Report

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FoHVOS
FRIENDS OF HOPEWELL VALLEY OPEN SPACE

Introduction

In 2022, Friends of Hopewell Valley Open Space (FoHVOS) received a grant from the Washington Crossing Audubon Society (WCAS) for $5,000 to fund the eighth season of the Eastern Copperhead radio-tracking program and habitat stewardship at the Ted Stiles Preserve at Baldpate Mountain. We used the grant to: (1) purchase the necessary items to continue the copperhead research project (telemetry receiver, data collection equipment, and surgeries to implant and/or remove transmitters), and (2) purchase native plants installed at select locations within critical copperhead sites.

Project Summaries

Eastern Copperhead Radio-Tracking

The Ted Stiles Preserve at Baldpate Mountain (hereafter Baldpate) contains what is believed to be the southernmost population of Eastern Copperheads (*Agkistrodon contortrix)* in the State of New Jersey. Copperheads are listed as a species of special concern in New Jersey, and are a candidate species to be upgraded to Threatened status.

Since 2016 FoHVOS has implemented radio tracking and stewardship of the Baldpate copperhead population. Each year our increasing knowledge from radio telemetry and associated data have provided valuable information regarding the spatial extent of the copperhead occurrence area at Baldpate, locations of critical sites (e.g., dens, shedding sites, gestation sites, birthing sites, etc.), their seasonal movements, and attributes of their habitats that can be replicated or enhanced through stewardship actions.

We utilized $3,892 of the $5,000 Holden Grant to conduct the eighth consecutive year of the copperhead radio tracking and stewardship program. This amount funded the purchase of a telemetry receiver and antenna that are used specifically for copperhead tracking, a surgical heart monitor, cost of implantation/removal surgeries, snake handling tubes and data collection equipment (tool case, binders, backpack, light/weather/temperature meters, and canopy cover camera). The remaining $1,108 funded the purchase of sixty native trees and shrubs.

Between April and October, 2023, a total of eighteen snakes were monitored (see Table 1). Four out of the eighteen snakes monitored died of predation between May and August (AGCO_42, AGCO_48, AGCO_58, AGCO_63). The eighteen snakes that were monitored during the 2023 season included ten females and eight males. Four out of the ten females were gravid and three were unknown (two due to predation before the gestation season began and one due to being released from the study), the remaining three were non-gravid. Five individuals were new to the study this year, four males and one female. Two of the males were found in a previously unknown den location at the beginning of the season. The third male and the female were found in a stewardship area where we had previously created debris piles and performed invasive control work to enhance the habitat quality in that area. The female was discovered to be a snake that we had captured as a gravid female late in the season in 2016. She was PIT-tagged with a small subcutaneous ID number in 2016 but was never implanted with a radio transmitter due to the timing

of her late-season capture, until she was recaptured in 2023 and added to the study. The fourth male was caught in an infrequently traveled area of the mountain in mid-September and fitted with a temporary external transmitter. The remaining 13 individuals had been part of the study previously (see Table 2).

Once radio-tagged, snakes were tracked once every 2 – 3 days. Upon each tracking, detailed data on habitat attributes and behavior were recorded to help inform future stewardship. The measurements taken include plant community metrics, ground cover data, and canopy cover, as well as courtship behavior, gestation observations, and communal interactions. These data have been instrumental in formulating an accurate understanding of the seasonal movements and habitat requirements of Baldpate copperheads. In 2022, a random point vegetation and ground plot attribute data collection protocol was added to the program and has continued in the 2023 season. Once a snake has been located and the data collected, we use randomly generated distances (1-50m) and directions (0-359degrees) to produce the location of the random point. We then collect the same data set at the random points as for the snake location. The goal is to increase our understanding of site selection preferences and how they compare to the random, non-selected sites available at Baldpate.

Table 1. List of Copperhead Individuals 2023

Individual ID	Sex	Reproductive Status	Seasonal Status
AGCO_16	F	Gravid	Overwintering
AGCO_37	M	N/A	Overwintering
AGCO_39	F	Unknown	Released
AGCO_42	F	Unknown	Predated/Deceased
AGCO_43	F	Gravid	Overwintering
AGCO_46	F	Gravid	Overwintering
AGCO_48	F	Unknown	Predated/Deceased
AGCO_51	F	Gravid	Overwintering
AGCO_53	M	N/A	Overwintering
AGCO_54	M	N/A	Overwintering
AGCO_58	F	Nongravid	Predated/Deceased
AGCO_59	F	Nongravid	Overwintering
AGCO_60	F	Nongravid	Overwintering
AGCO_63	M	N/A	Predated/Deceased
AGCO_66	M	N/A	Overwintering
AGCO_67	M	N/A	Overwintering
AGCO_68	M	N/A	Overwintering
AGCO_69	M	N/A	External/Shed

Table 2. Copperhead Individual Information 2023

Individual ID	Sex	Reproductive Status	Capture Status	Transmitter Status
AGCO_16	F	Gravid	New	Implanted
AGCO_39	F	Unknown	3rd Year	Removed/Released
AGCO_42	F	Unknown	3rd Year	Deceased
AGCO_43	F	Gravid	3rd Year	Implanted
AGCO_46	F	Gravid	3rd Year	Implanted
AGCO_48	F	Unknown	2nd Year	Deceased
AGCO_51	F	Gravid	2nd Year	Implanted
AGCO_58	F	Nongravid	2nd Year	Implanted/Deceased
AGCO_59	F	Nongravid	2nd Year	Implanted
AGCO_60	F	Nongravid	2nd Year	Implanted
AGCO_37	M	N/A	3rd Year	Implanted
AGCO_53	M	N/A	2nd Year	Implanted
AGCO_54	M	N/A	2nd Year	Implanted
AGCO_63	M	N/A	2nd Year	Implanted/Deceased
AGCO_66	M	N/A	New	Implanted
AGCO_67	M	N/A	New	Implanted
AGCO_68	M	N/A	New	Implanted
AGCO_69	M	N/A	New/Temporary	External

AGCO_54 using leaf litter and coarse woody debris as cover in May 2023

Rock Outcrop Stewardship and Native Plant Restoration

In early spring of 2023, FoHVOS staff preformed soil reduction and invasive control on rocky outcrops in an area that hosts three rare plant species (Yellow Giant Hyssop, Green Violet, and Eastern Redbud). Yellow Giant Hyssop and Green Violet thrive in outcrop conditions with limited soil. Since soil reduction began in 2020, we have seen a significant increase in population and reproduction. In 2019, the total estimated population size of Yellow Giant Hyssop in this area was 31, this number has now increased to over 450 naturally occurring individuals. In addition, between 2021 and 2022, FoHVOS staff planted a total of 250 Yellow Giant Hyssop seedlings that were germinated from seeds collected previously. In 2023, an additional 100 seedlings were germinated and planted in two other rock outcrop locations with suitable habitat where invasive species control and soil reduction were also performed. In 2019, the number of fruits produced within the Green Violet population was 45 and has since increased to 340. The fencing that protects the core area was maintained throughout 2023 and continues to provide a browse-free environment.

In the summer of 2023, the WCAS Holden grant also funded the purchase of 60 native trees and shrubs that were then planted within the 1-acre WCAS exclosure that was installed the previous year. The species chosen consisted of the following: Southern Arrowwood, Blackhaw Viburnum, Gray Dogwood, Ironwood, Persimmon, Red Chokeberry, and Service Berry. Invasive species were removed using herbicide early in the season and later, mechanically by hand due to the sensitive nature of this location. FoHVOS staff then planted the native trees and shrubs throughout the exclosure, choosing locations based on desired canopy coverage, species requirements, and soil quality. These plantings, along with previous plantings, will be cleared of invasives and protected from browse throughout future seasons through ongoing exclosure maintenance.

Yellow Giant Hyssop *(Agastache nepetoides)* planted in July 2023

FoHVOS staff after planting sixty native trees and shrubs

Eastern Copperhead Critical Site Stewardship

The 2023 radio tracking has continued to reveal the success of many past copperhead stewardship efforts. Starting in 2019, FoHVOS staff has created a number of artificial gestation sites and coarse woody debris piles based on the site selection and habitat data accumulated since the beginning of the project in 2016. In 2023, FoHVOS staff continued to apply the information gained from data collection and chose eleven locations to perform invasive species control and habitat stewardship at sites used for basking, breeding, foraging, courtship, gestation, and denning.

In 2022 and early 2023, a 0.5-acre canopy gap that was previously overrun with multiflora rose was treated and seeded with a native grass mix (stewardship location #1). This area is near other critical sites for the Eastern Copperhead and contains artificially created debris piles and naturally occurring rock piles within the treatment area. As a meadow environment, this location also provides foraging opportunities for snakes in and around the area, reducing the need for snakes to travel farther in search of meadow habitat. This year one female (AGCO_46) chose to gestate in this area, along with two untagged females. We also observed two other snakes in the study making use of this improved habitat at various times throughout the season. This area will be weed-whacked in late winter to keep vegetation "scaffolding" down to help manage Mile-a-Minute cover and allow grasses to germinate in the spring. Herbicide will continue to be used where appropriate in very early season before copperhead emergence to reduce Japanese Stiltgrass and Mile-a-Minute pressure. Our goal is to improve habitat quality within the canopy gap so fewer snakes will need to cross the Baldpate driveway in search of a meadow environment.

Invasive species removal was performed at a number of other critical sites in 2023 as well. A fieldstone area at the base of a rock outcrop that harbors both Green Violet and Yellow Giant Hyssop has historically been used by copperheads in the area (stewardship location #2). This location suffered from an infestation of invasives due to decreased canopy cover as a result of Ash death and Tree of Heaven *(Ailanthus altissima)* treatment. Throughout the season, invasives at this location have been removed to provide better growing conditions for Green Violet and to provide better habitat for copperheads. Autumn Olives *(Elaeagnus umbellata)* were treated along an important site that serves as a den and early season basking location to re-open the canopy and allow sunlight to reach the ground (stewardship location #3). Three other ridges and ledges in frequently-used copperhead habitat were also treated for invasives to restore the native plant community, decrease competition for sunlight, and provide basking areas (stewardship locations #4-6).

During winter of 2023, debris pile maintenance and creation took place. Two existing debris piles were added to, replacing lost material due to the natural process of decay and to maintain pile size and integrity (stewardship locations #7-8). Throughout the 2023 season, invasives at these artificial sites were removed by hand to decrease excessive vegetative cover and allow natives to grow free from intense competition. In early winter of 2023, FoHVOS oversaw the redistribution of a large pile of soil, logs, root mounds, and branches (a result of property maintenance and clearing of fallen trees) into three debris piles (stewardship locations #9-11). The original large pile was removed from an area with the potential for human-snake contact and three smaller piles were created in a known copperhead habitat area in an effort to draw the snakes away from risk factors that could result in harm to snakes or humans. FoHVOS had initially proposed that the large pile be divided into five piles but after beginning the redistribution

process, the decision was made to reduce the number of piles to three to ensure adequate pile size and temperature variation within each pile. As of September 2023, two of the three newly created piles have been used by one snake currently in the study (AGCO_51) and none of the snakes have been tracked to the location of the original debris pile that was previously identified as a potential hazard.

During the 2023 season, two snakes (AGCO_66, AGCO_67) were tracked to a large canopy gap and ash-death area on Baldpate outside of the known copperhead occurrence area. Stewardship activities, made possible by the WCAS Holden grants received in the past in conjunction with the NRCS grant previously awarded to FoHVOS, have taken place in this location for the past 3 years. Stewardship activities previously conducted in the area included invasive species control, installation of 14 exclosures that were planted with native trees and shrubs, and the creation of seven coarse woody debris piles. These findings, along with the success of 2023 stewardship efforts, suggest that (1) stewardship of forest sites and canopy gaps can effectively improve copperhead habitat quality, (2) creating artificial sites based on information learned through radio telemetry can provide suitable copperhead habitat, and (3) invasive species management and copperhead stewardship can be integrated in certain ecological scenarios to benefit multiple species.

Kaitlin Muccio locating AGCO_46 gestating in the new 0.5-acre meadow treatment area

Project Budget

At the time of writing, all $5,000 of the proposed budget has been spent on copperhead tracking materials and native trees and shrubs. Initially we were given a price quote for the telemetry receiver that was more expensive than the actual cost of the item. We also expected to need funding for twenty implantation surgeries but due to predation mortalities, we only had fifteen surgeries in 2023. We utilized this budget savings to purhcase ten additional native plants (five of which were large 7-gallon pots) and to purchase data organization and collection equipment that will improve our accuracy and efficiency while out in the field. These items included organization utensils (binders, folders, dividers), 2 snake handling bags, a weather meter that reads temperature, humidity, and wind speed, and an infrared thermometer which is used to take the surface temperatures of the snake and substrate. In addition to the costs covered by the Holden grant funding, FoHVOS contributed a total of $63,667.00 in staff and material costs (see Table 3).

Table 3. Budget Report

	Proposed Spending				Actual Spending			
Item Description	**Unit Cost**	**Quantity**	**Proposed Grant Funding**	**Proposed FoHVOS Match Funding**	**Actual Cost**	**Actual Quantity**	**Actual Grant Funding**	**Actual FoHVOS Match Funding**
Copperhead Transmitters (supplied by ENSP)	$ 177.00	16	$ -	$ 2,832.00	$ 177.00	16	$ -	$ 2,832.00
Copperhead Transmitters Mercer County	$ 177.00	5	$ -	$ 885.00	$ 177.00	5	$ -	$ 885.00
Copperhead Surgeries	$ 100.00	20	$ 2,000.00	$ -	$ 100.00	15	$ 1,500.00	$ -
Surgical Heart Monitor	$ 1,325.00	1	$ 1,325.00	$ -	$ 1,356.94	1	$ 1,356.94	$ -
Telemetry Receiver and Antenna	$ 800.00	1	$ 800.00	$ -	$ 459.68	1	$ 459.68	$ -
Canopy Cover Camera	$ 75.00	1	$ 75.00	$ -	$ 59.99	1	$ 59.99	$ -
Light Meter	$ 40.00	1	$ 40.00	$ -	$ 70.78	1	$ 70.78	$ -
Weather Meter					$ 158.98	1	$ 158.98	$ -
Data Organization Tools (binders, folders, dividers, etc)					$ 48.49		$ 48.49	$ -
Infrared Thermometer					$ 54.08		$ 54.08	$ -
Snake Handling Bags					$ 32.15		$ 32.15	$ -
Snake Handling Tubes	$ 50.00	1	$ 50.00	$ -	$ 61.37	10	$ 61.37	$ -
Backpack	$ 50.00	1	$ 50.00	$ -	$ 50.55	1	$ 50.55	$ -
Toolcase	$ 50.00	1	$ 50.00	$ -	$ 38.99	1	$ 38.99	$ -
Native Plants	$ 12.20	50	$ 610.00	$ -	$ 18.47	60	$ 1,108.00	$ -
Accord Herbicide (1gal)	$ 85.00	10	$ -	$ 850.00	$ 85.00	10	$ -	$ 850.00
Staff Costs To Date	N/A	2,364hrs	$ -	N/A	N/A	N/A	$ -	$ 53,650.00
Additional Staff Costs through December 2023	N/A	N/A	$ -	N/A	N/A	N/A	$ -	$ 5,450.00
Total Spending			$5,000.00				$5,000.00	$ 63,667.00

Project Team

All projects were conducted and completed by Friends of Hopewell Valley Open Space and Partners.

Eastern Copperhead Radio Telemetry	Stewardship
Dana Christensen	Dana Christensen
Cody Panek	Kaitlin Muccio
Kaitlin Muccio	Beth Craighead
Tyler Christensen	Seasonal Interns
Mike Van Clef	Mike Van Clef

Our Appreciation

Lastly, we would like to thank the Washington Crossing Audubon Society for its continued generosity and financial assistance. It is thanks to you that we have been able to continually work to preserve and protect the rare species that call Baldpate home.